Extensible Modeling to Create Knowledgebase for AM Processing of Alloy GrCop-84, Phase I
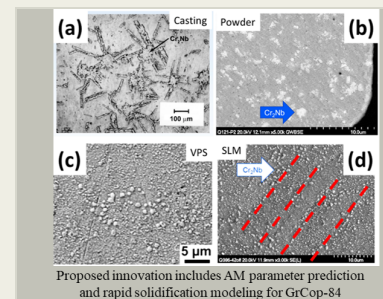
Completed Technology Project (2018 - 2019)

Project Introduction

The research objective of the proposed work is to demonstrate feasibility of utilizing extensible modeling to create an AM knowledgebase for copper alloy, GrCop-84, and utilize it to design an AM process for GrCop-84. The work plan has three tasks: (1) Utilize process modeling to demonstrate feasibility of predicting AM process parameters for alloy GrCop-84 for the powder bed and blown powder processes and generate parameter verification data. (2) Perform extensible modeling to generate an AM knowledgebase for GrCop-84 for the powder bed and blown powder processes. Demonstrate compatibility of extensible modeling for another alloy of interest to NASA by generating a knowledgebase for that alloy using existing data at AO. (3) Demonstrate feasibility of applying extensible modeling of the AM process and rapid solidification modeling of AM microstructure to mitigate build defects, dimensional errors, and microstructure inhomogeneity for either the powder bed or blown powder process for alloy GrCop-84. The deliverables are: (1) AM processing parameters; (2) AM knowledgebase to account for modest changes in parameters; (3) A microstructure model for rapid solidification; (4) Demonstration of feasibility to mitigate build defects, dimensional errors, and microstructure inhomogeneity.

Anticipated Benefits

The NASA commercial applications from the proposed work are to support the AM process developments for: (1) The transformation of liquid propulsion systems in reducing its cost, fabrication time, and overall part count; (2) The Journey to Mars, (e.g., MOXIE and SHERLOC); and (3) The human explorations and operations portfolio for Exploratory Systems Developments for Orion and SLS as well as the Commercial Crew Program, Dragon V2.

The non-NASA commercial applications from the proposed work are widespread. For example: (1) Replacement and repair of commercial jet engine components; (2) Conformal heat exchangers with enhanced thermal efficiency; and (3) Low-cost, low-volume, one-of-a-kind, non-critical components for industrial automation.

Proposed innovation includes AM parameter prediction and rapid solidification modeling for GrCop-84

Extensible Modeling to Create Knowledgebase for AM Processing of Alloy GrCop-84, Phase I

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Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
Applied Optimization, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB)	Fairborn, Ohio
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
The University of Tennessee-Knoxville(UT-K)	Supporting Organization	Academia	Knoxville, Tennessee

Primary U.S. Work Locations	
Ohio	Tennessee
Virginia	

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Applied Optimization, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management
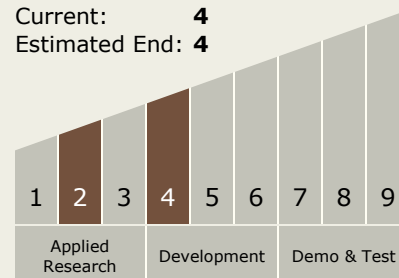
Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Anil B Chaudhary

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**

Project Transitions

▶ **July 2018:** Project Start

✔ **August 2019:** Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/141335)*
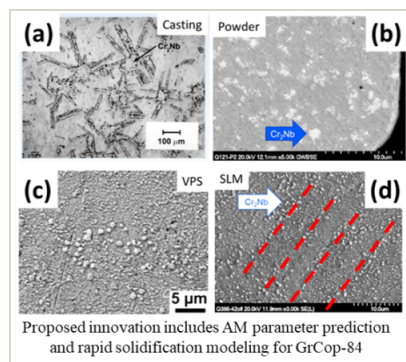
Images

Briefing Chart Image
Extensible Modeling to Create Knowledgebase for AM Processing of Alloy GrCop-84, Phase I
(https://techport.nasa.gov/image/131009)

Final Summary Chart Image
Extensible Modeling to Create Knowledgebase for AM Processing of Alloy GrCop-84, Phase I
(https://techport.nasa.gov/image/130274)

Technology Areas
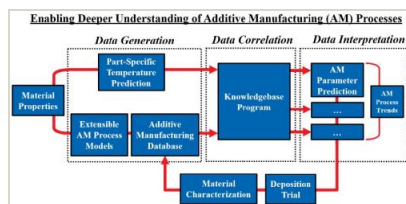
Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  └ TX12.4 Manufacturing
    └ TX12.4.2 Intelligent Integrated Manufacturing

Target Destinations

Earth, The Moon, Mars

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